Designing MS Supply Chain Management program using quality function deployment

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Abstract - **Course design is an important component in the success of academic programs. The design and execution of the academic programs according to the demand of the industry leads to the success of its graduates in their careers. Current study narrates the process through which academic program for Master of Science in Supply Chain Management (MS-SCM) has been designed by a university in a developing country based on customer demands considering prospective employers as customers. In order to convert customer requirements into the program courses "quality function deployment" (QFD) has been used. The "house of quality" is the tool of QFD that has been used to translate requirements of the prospective employers into the courses to be offered in the program. In order to learn about the voice of customer a small scale survey of the managers from a variety of organizations has been conducted who play a role in the recruitment of new candidates in their respective departments. Based on the demands of the managers, courses with suitable content have been identified that can meet the requirements of the potential employers. This study shows how by using QFD, educational policy makers can customize the academic programs to the requirements of the employers.**

Keywords – **MS program, supply chain management, quality function deployment.**

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I. Introduction

The concept of supply chain management has evolved over the past few decades to become one of the most significant areas of management. This area of management covers many aspects of the business in order to satisfy the customer's needs in an appropriate way. Companies are competing with others in improving their supply chains. Few decades back every company concentrated on its own organizational interests, resulting in the supply chain costs to increase to extraordinary levels, and hostile relationships between the supply chain partners [1]. Currently the focus has shifted from a single organization's objective to the overall supply chain objective, resulting in organization's integration with its suppliers and in some cases suppliers of its suppliers [2] to get the maximum benefits and to get competitive advantage in supply chains [3]. This shift of focus requires support from the academic institutions that need to prepare future graduates having skills and capabilities to achieve high performance standards in supply chains. Hwarng and Teo (2001) [7] suggested that higher education should result in development of skill set that enables individuals in becoming effective problem solvers.

The course design is an important component in the success of academic programs. The design and execution of the academic programs according to the demand of the industry leads to the success of its graduates in their careers. For designing Master of Science in Supply Chain Management (MS-SCM) program the main theme is to develop the curriculum with respect to the customer's voice. To achieve this purpose, the technique of Quality Function Deployment (QFD) has been utilized. Quality function deployment is an important tool of Total Quality Management (TQM) as it facilitates the companies to act according to the "voice of the customers" right from the start of the business process. The "house of quality" is the tool of QFD that has been used to translate requirements of the customers into the product specification [4].

The theme of this paper is to evaluate MS-SCM program using QFD technique. QFD is largely

used for the new product development [5, 6], but in this paper technique of QFD is modified and used for designing the program curriculum. The use of QFD for designing an academic program has not been widely adopted or practiced in the universities [7].

The objective of the MS-SCM program is to develop professionals who have the necessary technical and managerial abilities to design and manage effective supply chains. Use of quantitative models for decision making is supplemented by the development of managerial skills required to manage complex supply chains in a variety of industry.

This study shows how by using QFD, educational policy makers can customize the academic programs to satisfy the requirements of the employers.

II. Literature Review

A. *Supply chain management*

Today when business operations are going global, companies are in continuous process of evolution and adopting technologies to have an edge over their competitors. Cost effectiveness, increased reliability and higher supplier cost are the few major challenges; the organizations are facing [8]. This brings in the phenomenon of supply chain management which is considered to be the new approach for the survival of businesses in the 21st century.

Supply chain management includes all the activites that add value from the extraction of raw material to finished goods and then delivery to the customers [2]. This concept also includes the rapid and responsive logistics service, effective supplier management, customer relationship managent and effective usage of information technology [3].

B. *Quality in Education*

Supply chain managament is becoming important field in the current era, Now this is a challenge for the univerisies to produce such graduates that will become the future leaders of this field. This need gives rise to the need to provide quality eduaction to the students [9-11]. In order to move forward and attain a higher level of quality in education, the concept of quality management must be applied in designing and delivering the curricullum of higher education [12]. Continuous quality improvement in academic institutions means exploring the needs and expectations of the institutions' customer base, who may be the faculty, the students, the staff, the future employers, and the members of the community[13].   Current study

discusses the use of quality management tools in designing a high quality academic program.

C. *Quality function deployment (QFD)*

In the past decades quality has evolved from the notion of mere inspection of the products to a comprehensive set of activities resulting in total customer satisfaction. Quality improvement tools on-line techniques like statistical process control, as well as off-line methods such as Quality Function Deployment (QFD). The use of QFD was initiated in 1970s when Japanese companies started using it to improve the design of their products. QFD focuses and coordinates skills within an organization. The first step is to design the product, then to manufacture it, and then to market the product that customers are willing to purchase. The basis of the QFD is the belief that the products should be designed according to the customer's demands and an organization will not substitute the perceived quality of the customer in order to provide value. To achieve this goal of making a product according to the customers, all the functional departments must work closely. This process uses a series of matrices, commonly known as the House of Quality (HOQ), to study and analyze the relationships, the importance, and the trade-offs between various factors of customer requirements and product characteristics [4]. The purpose is to translate customer requirements into activities that result in the development of products and services according to the customer requirements [14]. Miguel (2007) [5] showed that QFD may result in development of innovative products. Shiu, Jiang et al [15] discussed the product and process development using QFD. Duffuaa (2002) [25] discussed the usage of QFD in maintaining work planning process.

a. *QFD in service industry*

Quality measures are as important to the services as they are to the products. However the application of quality tools to services sector is more challenging due lack of tangibility of services. Service process has to continue regardless of the complaints from "unskilled customers" (e.g. students, patients) who are actually an integral part of the manufacturing (or delivery) process. In this regard service organizations can greatly benefit from tools and techniques that can help them in developing design and delivery systems for their services [16]. QFD is a useful tool for the service organizations that helps them in achieving this goal. It provides managers with tools that help them to design effective service strategies [17]. QFD contributes to design effective services resulting in higher competitiveness [18].

In terms of methodology QFD is applied through a set of matrices of which the first and the most commonly used matrix is the house of quality (HOQ) [18]. Typical structure for HOQ consists of four matrices. These matrices translate customer requirement into design characteristics (house 1); design characteristics into specific components (house 2); specific components into production process (house 3); and production process into quality plan (house 4) [19]. This structure is slightly modified into three matrix structure for services [18, 20]. First of the three matrices incorporates the customer perspective while the remaining two matrices help in identification of critical service measures, design characteristics, and quality plan [20]. Current study presents the house of quality which is first of the three matrices for the design of MS-SCM program.

b. *QFD in education*

The "table I" given below briefly describes the use of quality management tools in the education sector.

TABLE I

Authors	Research Findings
Temtime and Mmereki (2011) [21]	Used Kano model to guide and develop educational services by including the Voice of the Customer using QFD.
Gonzalez, Quesada et al. (2008) [22]	Designed a supply chain management academic curriculum using QFD and benchmarking
Temponi (2005) [23]	Used the main elements of continuous improvement (CI) in higher education and discussed the concern of academia's stakeholders in the implementation of this method.
Aytac and Deniz (2005) [24]	Reviewed the curriculum of the Tyre Technology Department at a vocational school by using the quality function deployment (QFD) technique.
Srikanthan and Dalrymple (2003) [10]	Developed several alternatives prospective on quality in higher education, through the review of current approaches, by looking at the practices of the quality and through comparisons with the industrial quality systems.
Duffuaa, Al-Turki et al. [25]	Established the use of quality function deployment in designing courses and demonstrated its use in the designing of a basic statistics course.
Lam and Zhao (1998) [26]	Quality function deployment was used for improving the quality of the teaching in the university.
Owlia and Aspinwall (1996) [9]	Study the conceptual models proposed for different environments for consistency with higher education and presents a new framework for the dimensions of quality in higher education.
Pitman, Motwani et al. (1996) [27]	Demonstrated how the quality function deployment (QFD) method can be used to measure customer satisfaction in educational institutions
Mazur (1996) [28]	Used quality function deployment for designing total quality management course

In this study, the most important customer's requirements (Voice Of Customer) that are required for supply chain management curriculum are adopted from the study conducted by Gonzalez, Quesada et al. (2008) [22] which used quality function deployment and benchmarking for designing supply chain management curriculum. Information regarding customer expectations was collected by conducting a survey of the managers involved in various functions of supply chain. A total number of 1595 customer requirements were gathered from this survey. The Dynamic Analysis Reduction Process (DARP) was used for reduction of this number. The DARP determined 29 variables/ expectations that are related directly with supply chain management.

In this study future employers are considered as the primary customers of the graduate program in supply chain management. Employers as customers for the universities are considered by many authors [22, 24, 25, 28]. Potential employers know what combination of skills and knowledge will best equip the graduates for the world of work.

III. Research Methodology

In this study, the researchers collected the information on customer expectations from potential employers. For the purpose of gaining the data about the customer expectations, a questionnaire was distributed among managers of various organizations working in the areas of supply chain management. The researchers collected the cross sectional data by catering to the different industries. The questionnaire was sent to 34 potential employers in the area of supply chain management, 27 questionnaires

received in return out of which 22 questionnaires were usable.

The respondents of this research were supply chain managers, purchasing managers, plant managers, warehouse managers, and logistics managers. Multiple informant approach was used to collect the perceptual information regarding the relative importance of the 26 customer requirements adopted from Gonzalez, Quesada et al. (2008) [22].

The questionnaire was combination of 3 sections; the first section consisted of 26 questions related to customer's expectations, the respondents had to show the degree of importance for each skill. The second section was an open ended question for the respondents that if they expect any other skills from the executive working in the field of supply chain. The last section is of the personal information of the respondent. After the collection of data research team thoroughly evaluated the supply chain program and customer's expectations and constructed house of quality for designing MS-SCM program shown in Figure 1. The following section after the figure explains in detail the construction of this house of quality.

IV. House of Quality

The "house of quality (HOQ)" has been used to translate requirements of the prospective employers into the courses to be offered in the program. The researchers identified potential employers as the institution's primary customers. The institution's objective was to design a quality MS-SCM program in order to satisfy the requirements of its customers. This motivated the researchers to use the HOQ to develop internal measures for quality and excellence in specific and identified area, and redesign the MS-SCM program.

Describing the HOQ, the first column on the left side of the HOQ given above shows the customer's requirement. The column next to the customer's requirement demonstrates rating (Average) given by the potential employers to each critical variable. The row on the top is the list of the courses currently offered by the university in MS-SCM program. The central part of the HOQ depicts the strength of relationship (Strong, Moderate, Weak) between customer's requirements and the courses offered by the university. The last column on the extreme right is weighted average calculated using the formula (Importance Average $\times$ Sum of all the relationship strength) for example for Production and operation Knowledge $\{4.59*(9 + 9 + 9 + 1 + 1)\} = 152$ where the numeric scores for relationship strengths are assigned as: Strong = 9, Moderate = 3, Weak = 1. The row on the bottom of House is the accumulated importance of the courses offered by the

university. This is calculated by (Sum of all the relationship strengths) i.e. for Managing Supply Chains ($9 + 9 + 9 + 1 + 1 + 9 + 1 + 1 + 3 + 9 + 9 + 3 + 3 + 3 + 9 + 3 + 3$) = 85 where the (Strong = 9, Moderate = 3, Weak = 1). The roof of the house shows the internal relationship between the different courses. They are used to identify courses that are highly correlated.

After the detailed discussion/analysis on the relationship between the critical variables and the courses, the researchers found out that the courses in Managing Supply Chains (85), Production Planning and inventory Control (93), Purchasing and Sourcing (60) and Supply Chain Strategies (63) are most important courses that are offered in the MS-SCM program. These courses are covering more critical variables that are rated high by the employers. These four courses are considered to be the back bone of this program. Whereas Strategic Distribution Network (50), Supply Chain modeling (49) and Forecasting in Supply Chain (49) have moderate relationship. Supply chain Finance (28), Enterprise Resource planning (31), Logistics Management (32), Customer Relationship Management (32), Project management (36) and Thesis (32) are having weak relationship with the variables. There is a lot of room for improvement in many courses to delight the customers. The researches decided cut-off points to eliminate the courses that score below the cutoff point, the courses that are having importance less than 10 (<10) will not be offered in this program. Therefore Research Methodology (3) is the only course that is considered to be the most inappropriate course that is offered in MS Supply Chain Management program. The main focus of this course is to give knowledge about the procedure of doing research that helps in doing Thesis and making contribution in knowledge creation that is why this course rated very low in the House.

The data collected through the questionnaires shows that the expectation about Knowledge of Regional/ Local supply chain was ranked as the most important skills that future professionals need to develop. This factor must be considered seriously in the final MS program.

After the evaluation of the data collected from the future employees Knowledge of Regional/ Local supply chain (4.68), Supply chain management knowledge (4.64), Production and Operation Knowledge (4.59), Forecasting skills (4.59), Inventory management skills (4.50), Supplier relation knowledge (4.45), Logistics knowledge (4.41) and Procurement knowledge (4.36) are the most critical expectations and must be addressed in supply chain management academic program.
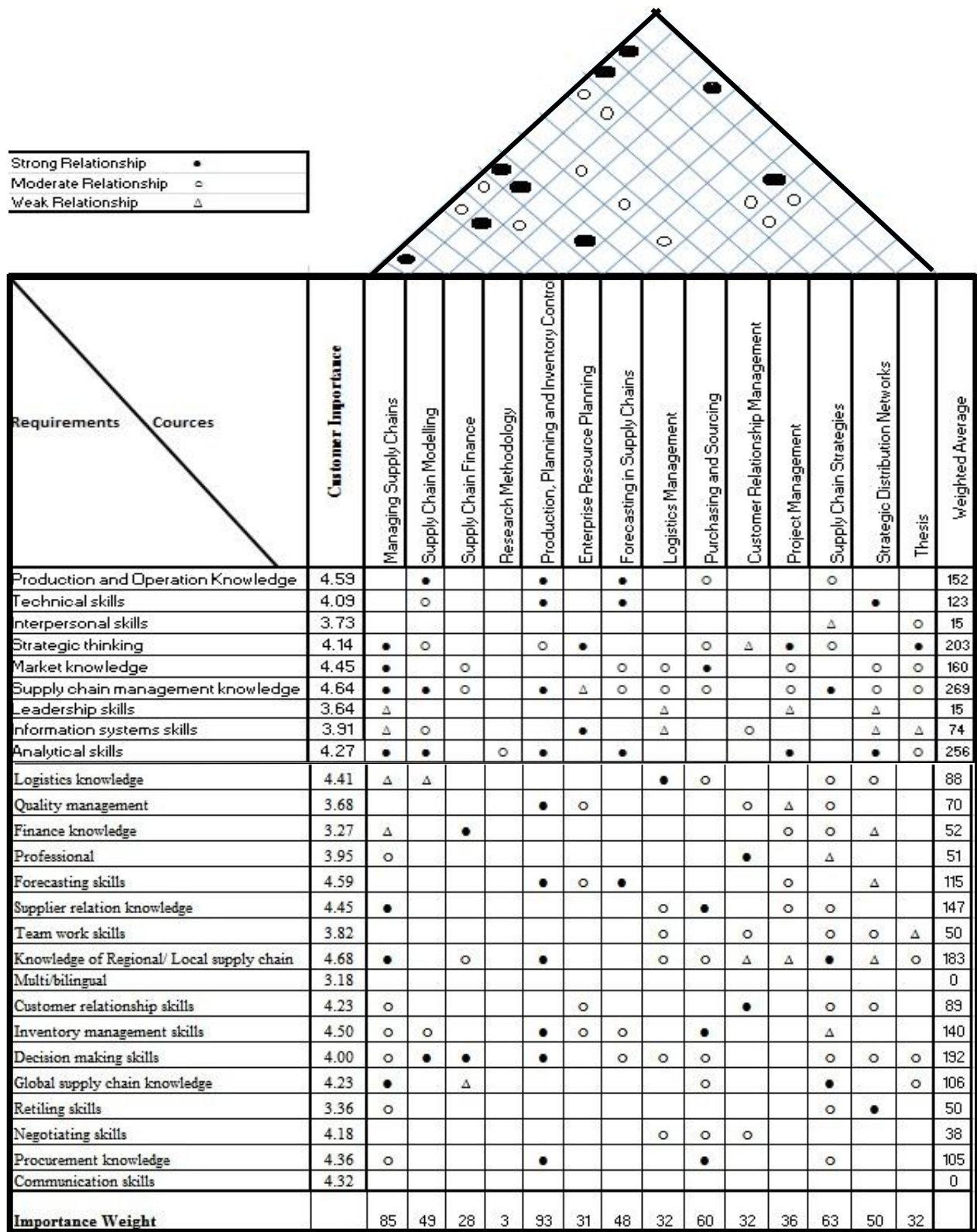
Strong Relationship   •
Moderate Relationship   o
Weak Relationship   Δ

Requirements \ Cources	Customer Importance	Managing Supply Chains	Supply Chain Modelling	Supply Chain Finance	Research Methodology	Production, Planning and Inventory Control	Enterprise Resource Planning	Forecasting in Supply Chains	Logistics Management	Purchasing and Sourcing	Customer Relationship Management	Project Management	Supply Chain Strategies	Strategic Distribution Networks	Thesis	Weighted Average
Production and Operation Knowledge	4.59		•			•		•		o			o			152
Technical skills	4.09		o			•		•						•		123
Interpersonal skills	3.73												Δ		o	15
Strategic thinking	4.14	•	o			o	•			o	Δ	•	o		•	203
Market knowledge	4.45	•		o				o	o	•		o		o	o	160
Supply chain management knowledge	4.64	•	•	o		•	Δ	o	o	o		o	•	o	o	269
Leadership skills	3.64	Δ							Δ			Δ		Δ		15
Information systems skills	3.91	Δ	o				•		Δ		o			Δ	Δ	74
Analytical skills	4.27	•	•		o	•		•				•		•	o	256
Logistics knowledge	4.41	Δ	Δ						•	o			o	o		88
Quality management	3.68					•	o			o	Δ	o				70
Finance knowledge	3.27	Δ		•						o	o		Δ			52
Professional	3.95	o								•			Δ			51
Forecasting skills	4.59					•	o	•				o		Δ		115
Supplier relation knowledge	4.45	•						o	•			o	o			147
Team work skills	3.82							o		o		o	o	Δ		50
Knowledge of Regional/ Local supply chain	4.68	•		o		•		o	o	Δ	Δ	•	Δ	o		183
Multi/bilingual	3.18															0
Customer relationship skills	4.23	o				o				•		o	o			89
Inventory management skills	4.50	o	o			•	o	o		•			Δ			140
Decision making skills	4.00	o	•	•		•		o	o	o		o	o	o		192
Global supply chain knowledge	4.23	•		Δ					o			•		o		106
Retiling skills	3.36	o									o	•				50
Negotiating skills	4.18							o	o	o						38
Procurement knowledge	4.36	o				•			•			o				105
Communication skills	4.32															0
Importance Weight		85	49	28	3	93	31	48	32	60	32	36	63	50	32	

Figure 1: House of Quality

"Table II" shows the potential employers rating and the weighted average of the variables that are currently offered in the MS-SCM program of the university. The two most important aspects i.e. employees Knowledge of Regional/ Local supply chain and Supply chain management knowledge are very well covered by the current MS program this seems an achievement and shows that university is currently producing good and required post graduate students. The current program is also covering the other variables that are given in Table I. The researches decided cut off points to properly cover those variables that are below that point, the variables that are having weighted average less than 50 (<50) will be considered in this program and the variables that are closer to 50 will also be kept in mind while designing the new MS program for the overall improvement of the degree. However there is issue in the Logistics knowledge, it is ranked as number seven from the 26 important variables this shows the importance of the logistics knowledge but the weighted average is comparatively low therefore this should be properly addressed by the policy makers.

Table II

Courses	Customer's Importance Rating	Weighted Average
Knowledge of Regional/ Local supply chain	4.68	183
Supply chain management knowledge	4.64	269
Production and Operation Knowledge	4.59	152
Forecasting skills	4.59	115
Inventory management skills	4.50	140
Supplier relation knowledge	4.45	147
Logistics knowledge	4.41	88
Procurement knowledge	4.36	105

After the detailed discussion/analysis on the relationship between the critical variables and the courses, the data collected from the potential employers gives us evidence about many variables that are marginally important that are Communication skills (0), Bilingual (0), Leadership Skills (15), Inter personal Skills (15) and Negotiating Skills (38) but are having lowest weighted average and are weakly addressed in the current MS-SCM program. Table II shows the customer's rating and the weighted average of the weak areas. There are

few customers' expectations that are of significant importance and the current MS-SCM program is also covering them as they are above the cutoff point that was decided by the researchers. However, the analysis suggests that there seems to be lots of room for the improvement in the current MS-SCM program.

Table III:

Customer's Requirement	Customer's Importance Rating	Weighted Average
Communication skills	4.32	0
Negotiating Skills	4.18	38
Inter personal Skills	3.73	15
Leadership Skills	3.64	15
Bilingual	3.18	0

None of the other universities in the particular region is offering MS-SCM program, therefore comparative analysis for competitors could not be done in this study.

V.   Propositions

This research has an important contribution as it suggests a mechanism for designing academic programs that are in accordance to the customer expectations. The requirements of the potential employers can be incorporated in the program at the early design stage. In this study the researchers translated the customer's expectations that are known as "What's" in the QFD terms in to "How's" through use of HOQ. The current study indicates many action plans that may be implemented in order to satisfy the customer's expectations. The university may exclude the course of Research methodology as it does not fulfill any of the customer's expectations. This course is more related to the academic research rather than the market research. Another proposition is that the university may offer the MS-SCM program with two options; Thesis and Non-Thesis. Students with work experience in industry and intention to continue working in the industry in field of supply chain may opt for Non-Thesis option with no requirement of course in Research Methodology. On the other hands students with interest in research and future plans to be in academia may opt for the Thesis option, which will require them to take the course in Research Methodology.

There is a need to increase the course content related to the knowledge of regional/ local supply chain although the current program is already

covering it in a better way but this should also be considered as it is on the top priority of potential employers.

The new MS-SCM program should accommodate the course content related to Forecasting skills, Logistics knowledge and Procurement knowledge. These three expectations are in the top eight important expectations hence these expectations content will be divided into different courses in an overall mission to delight the customers by the new MS-SCM program.

The new MS-SCM program must focus on the soft skills that are needed in the industry. The present program is very weak in polishing the soft skills of the students like communication skills, bilingual, leadership skills, interpersonal skills and negotiating skills. The research team suggests a new course by the name "Skills and Personality Development" that will include the content related to the soft skills. This new course of Skills and Personality Development will replace the course of Research Methodology, for the students opting for Non-Thesis option.

The university should devise a mechanism to periodically evaluate customer expectations in order to deal with the ever changing business environment. It is discussed earlier that there is no other institution in the region currently offering MS-SCM program. Therefore improvement in program will provide the case university a significant competitive advantage. This new MS-SCM program will be better aligned with the customer's requirements and will strengthen the position of its graduates in the corporate sector in areas of supply chain management.

VI.   Conclusion

The quality function deployment concept emerged few decades back as a methodology to design the products and services on the basis of customer requirements. This study demonstrates the effectiveness of the application of this technique in academics, and suggests to the universities an effective way of designing programs according to the customer's demand. This study describes the case of application of QFD to design a more effective MS-SCM program at a university in a developing country. The case study shows how QFD may help the university in identifying the courses that are not adding much value, along with identifying the areas that needed more focus. The results of the QFD suggested the policy makers to exclude one course from the program and propose them to focus on the few customer requirements that are not being thoroughly addressed by the current courses. The

present MS-SCM program is weak in polishing the soft skills of the students. For this purpose a new course should be introduced to overcome these weaknesses. Another suggestion was to offer the MS-SCM program with two options of either with thesis or without thesis to cater for varying needs of the students and potential employers.

Currently the case university is the only university in the region that is offering MS program in the increasing important area of supply chain management. Hence these improvements suggested by application of QFD will be useful in developing a state-of-the-art MS-SCM program, and set it as the benchmark for the other universities that may offer similar programs in future in SCM and other areas.

VII.   Limitations and Future Research

The current study has only used employers as the voice of customers ([22]. Further studies may include the voice of other stake holders such as students, their parents, faculty, etc as pointed out by Cruickshank (2003) [13]. Another limitation of the current study is that it is only confined to the construction of the first house of quality in the application of QFD in designing the MS-SCM program. Future studies may extend this to include construction of other houses of quality to make the application of QFD more comprehensive and hence further increase its effectiveness.

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